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**(12) UK Patent Application (19) GB (11)**

**2 165 715 A**

(43) Application published 16 Apr 1986

(21) Application No 8522390

(22) Date of filing 10 Sep 1985

(30) Priority data

(31) 3433146

(32) 10 Sep 1984

(33) DE

(51) INT CL<sup>4</sup>  
G01S 13/88

(52) Domestic classification  
H4D 244 30X 336 467 RPK  
F3C TF  
U1S 1198 F3C H4D

(56) Documents cited  
None

(58) Field of search  
H4D F3C

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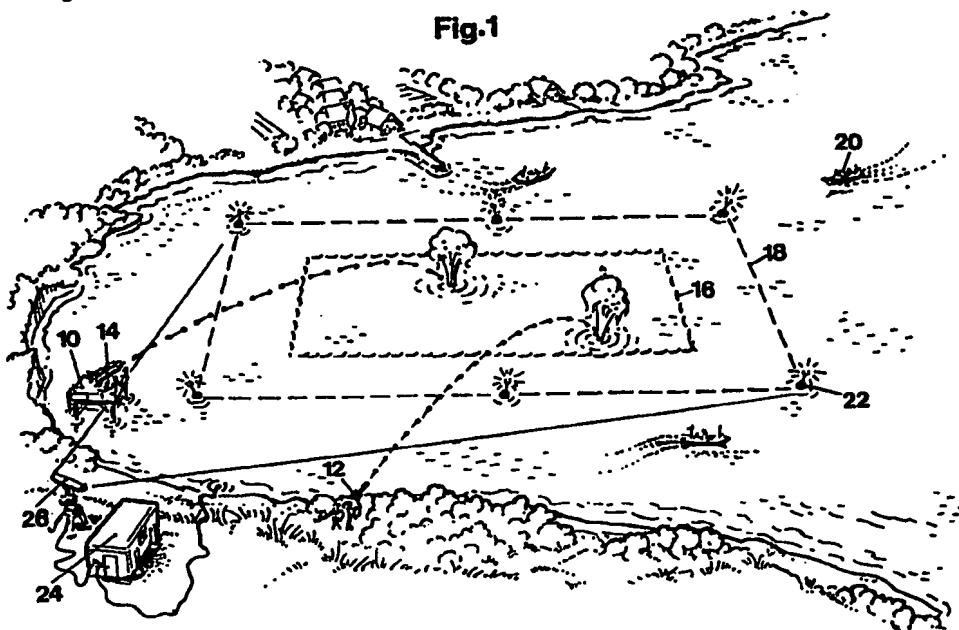
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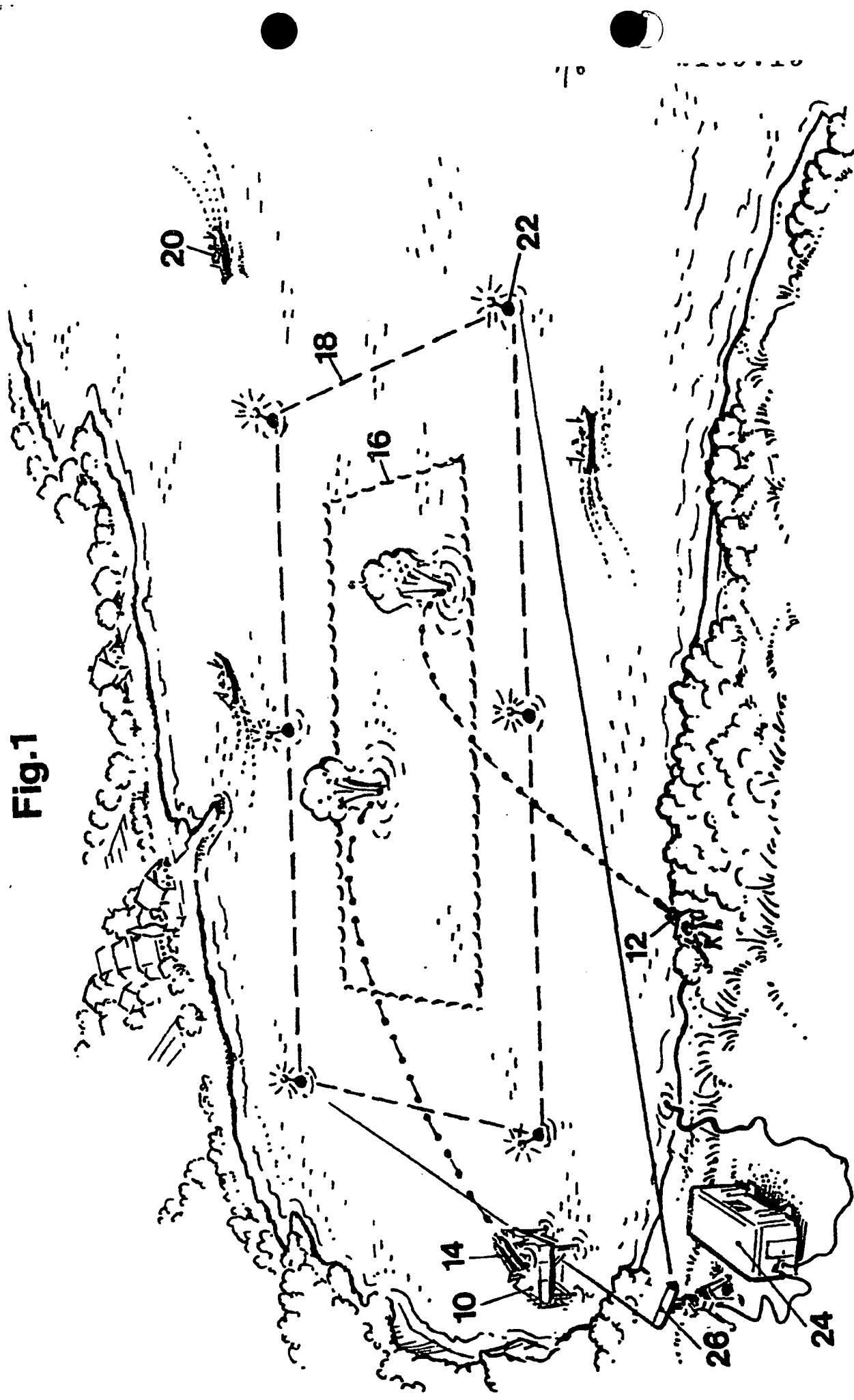
**(54) Measuring and search system**

(57) A multifunctional measuring and search system monitors the intrusion of objects, in particular fishing vessels (20), into a safety zone (18), and additionally monitors the impact of projectiles within an impact zone (16) by means of a radar device (26) which is put into a splash spotting mode at triggering of a shot so that the location of the column of water and spray may be detected. By means of memorizing a recovery or salvage cadastre, i.e. the topography and nature of the ocean floor, and taking into consideration the variable water level it is possible to compute and to display the location of impact and the penetration depth of said projectiles on the ocean floor when taking into account the impact angle resulting from the projectile ballistics and the velocity of said projectiles.

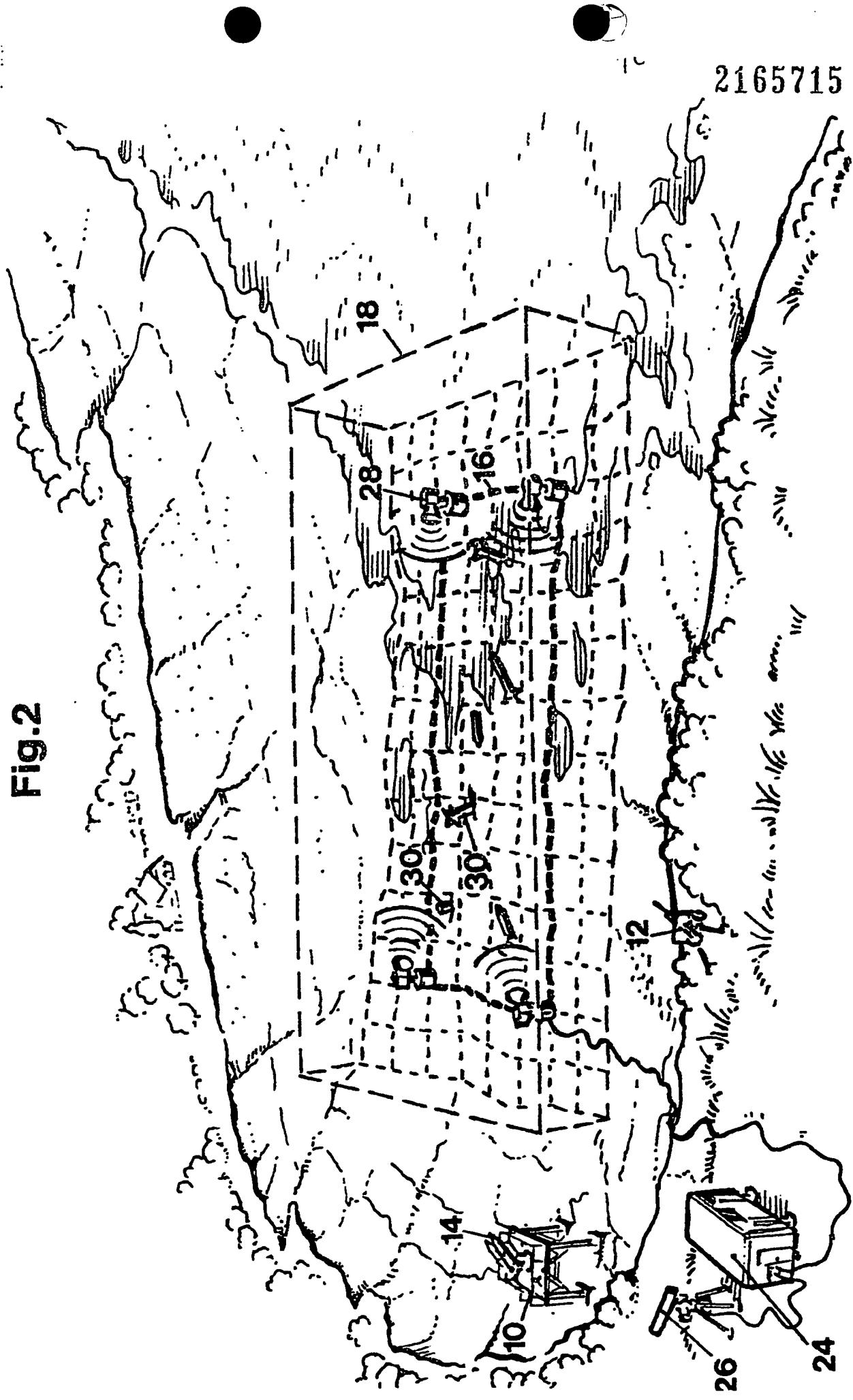
**Fig.1**



**Fig.1**



**Fig.2**



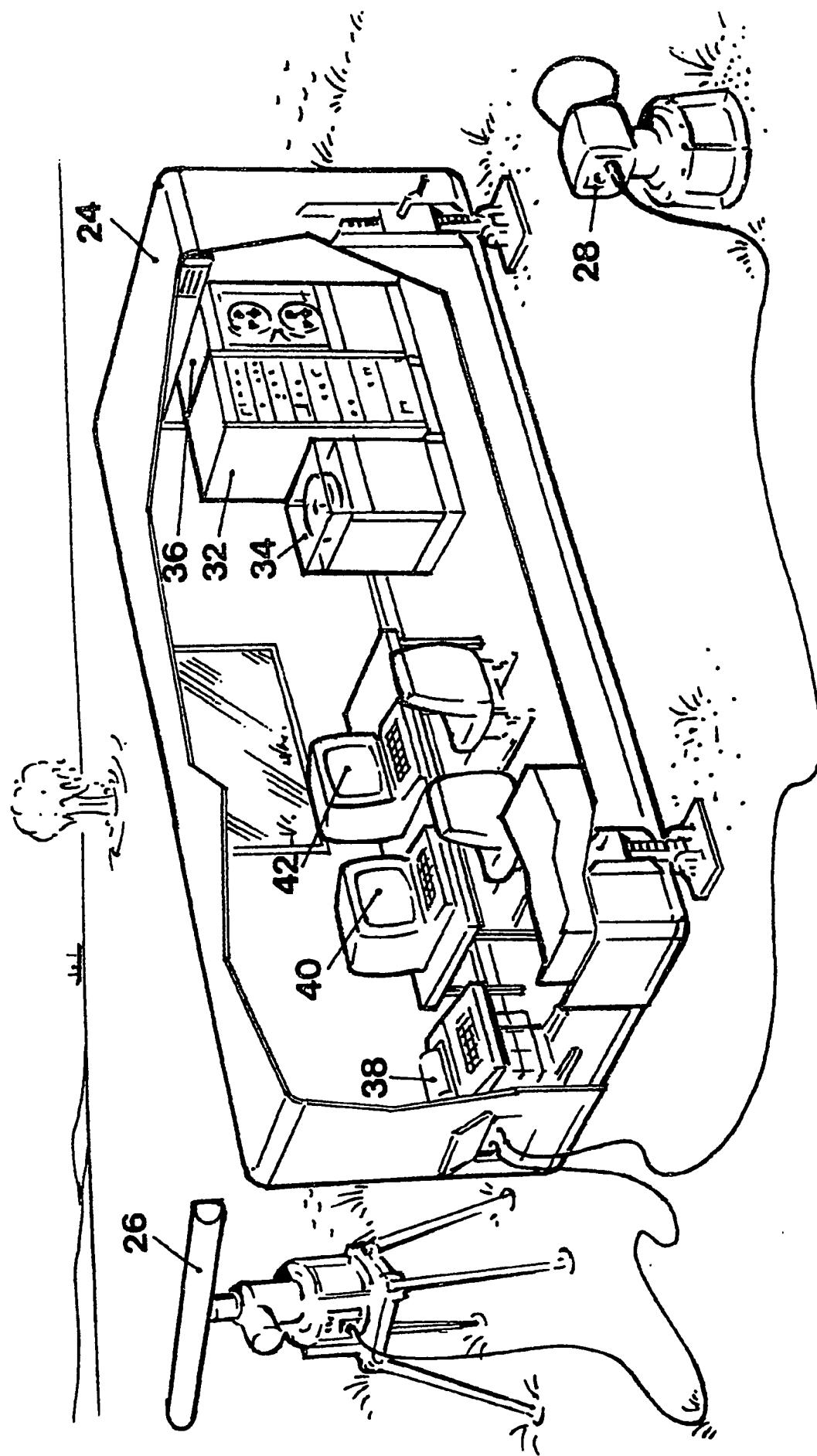
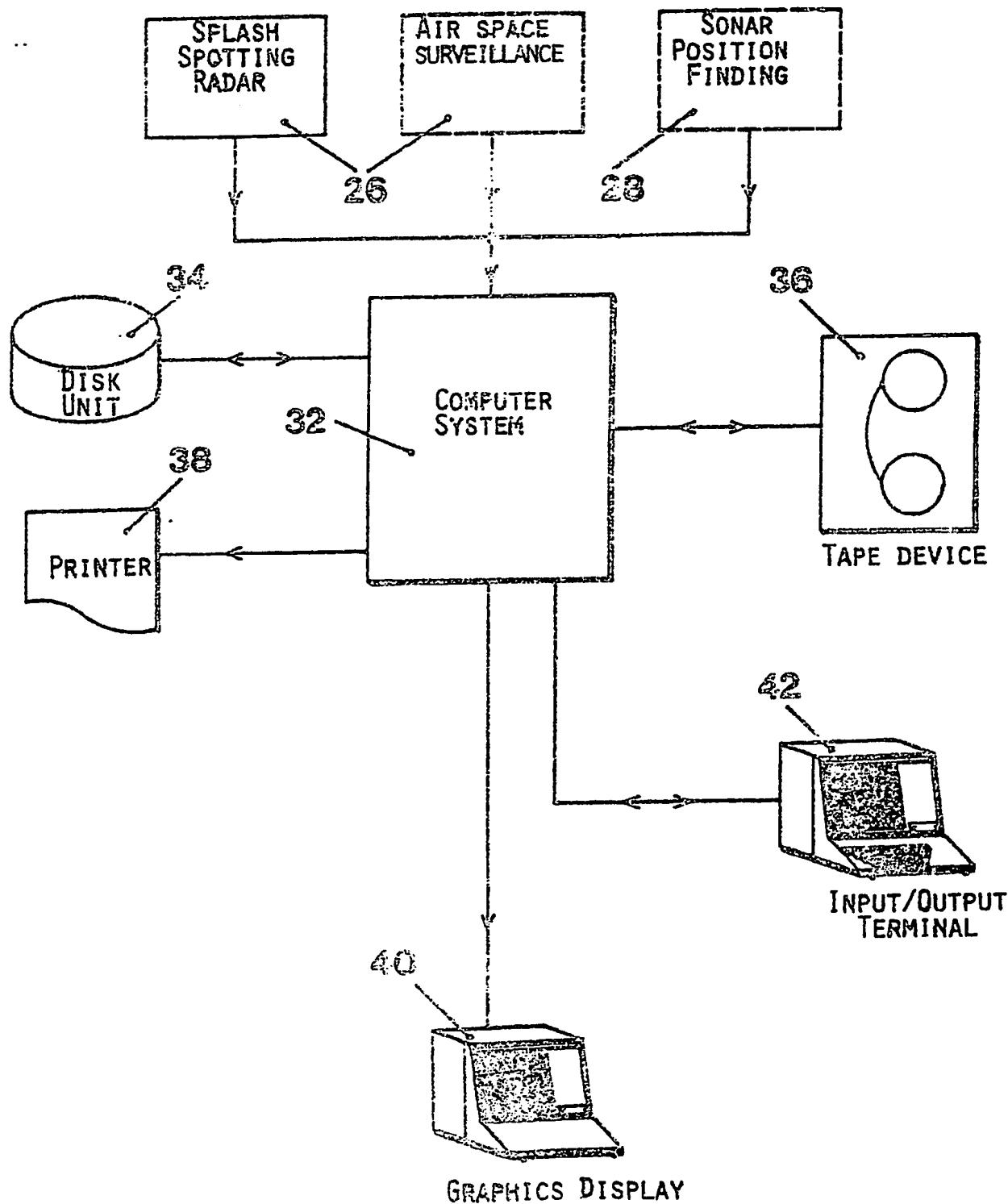


Fig.3

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FIG.4



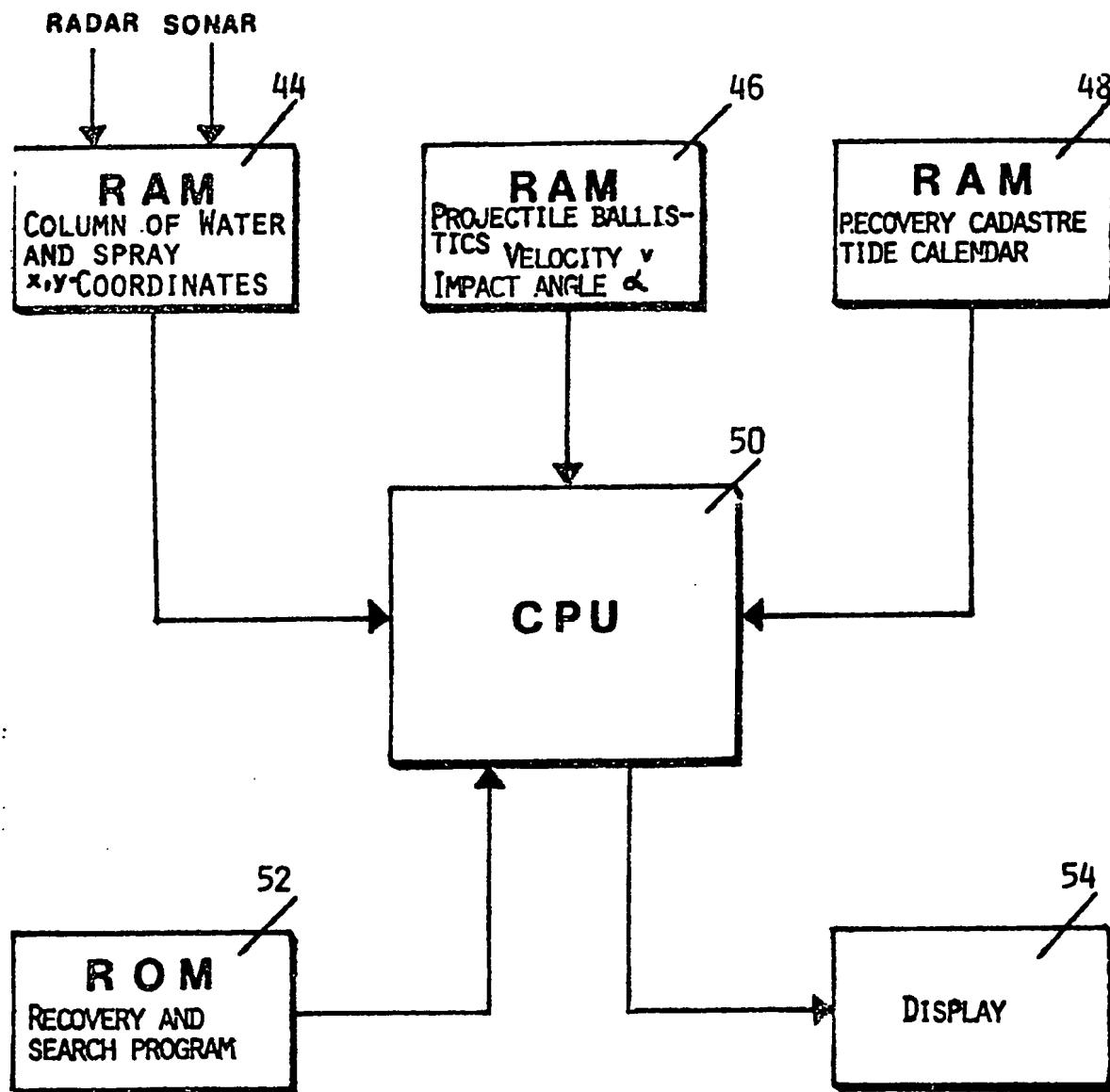
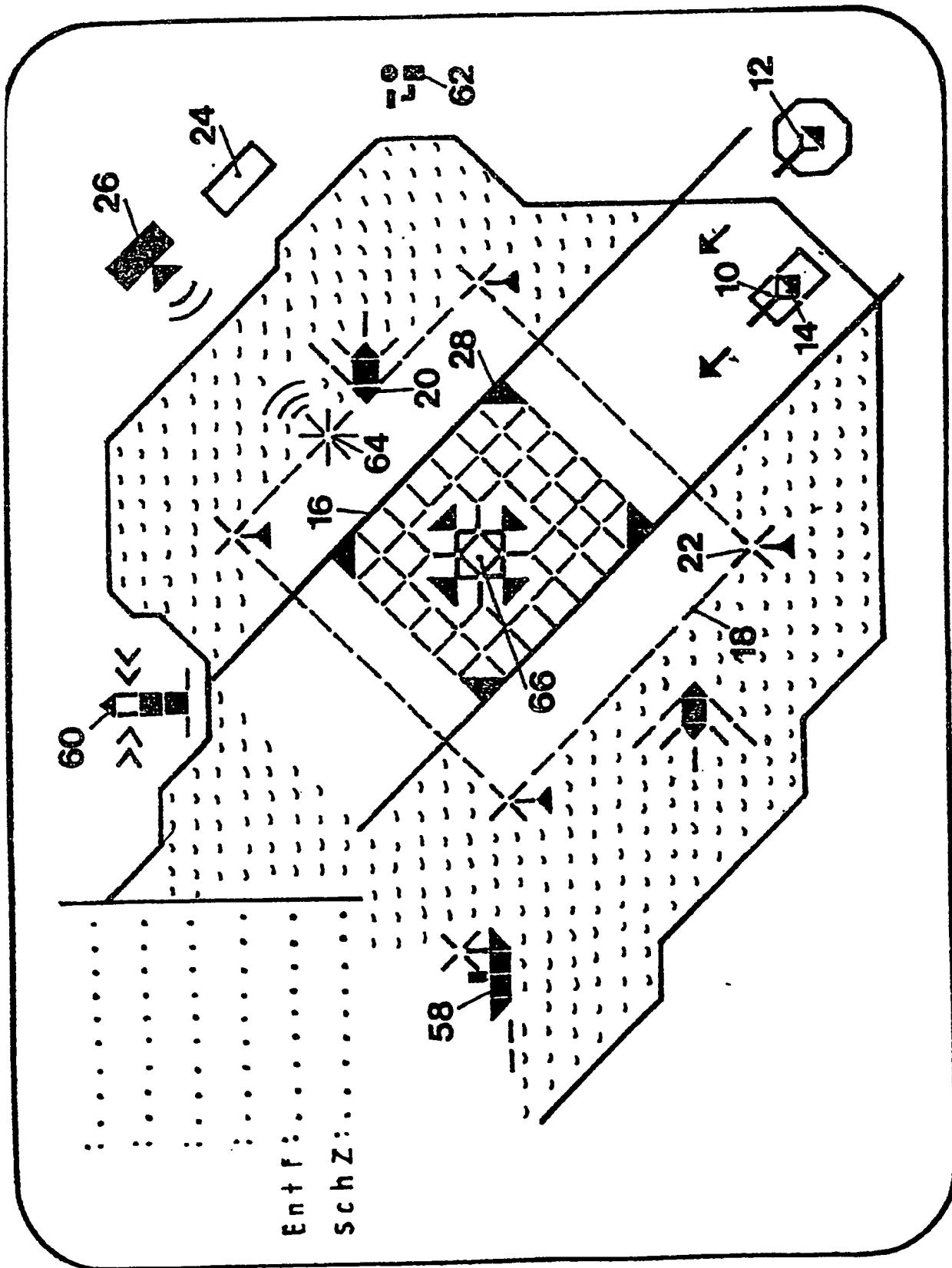


Fig.5

Fig. 6



## SPECIFICATION

### Measuring and search system

5 The present invention relates to a multifunctional measuring and search system comprising detector means for detecting objects such as projectiles moving above a water surface and a computer connected to memories and display devices for 10 evaluating and displaying detected data.

From German published patent application DE-OS 32 44 255 it is already known to track the movement of objects being detected by sensors with the use of a computer and to display and monitor the computed 15 trajectories on display devices within a central command station. There optronical sensors are used which are located at least in two different positions and the signals of which are combined according to the method of triangulation. Such a system may be 20 used in order to monitor a plurality of objects which are movable on land, water or in the air. When shooting into a certain target area, the known system also can be used to detect whether this area is free of objects which should not be endangered.

25 Shooting test stations are often situated in coastal areas, and in particular in bays, where the tidal differences can be used to recover the projectiles at low tide within the area. This cannot always be implemented in a simple manner since for instance 30 such a projectile may be sunk in mud and the point of impact is not precisely known.

It is therefore the object of the present invention to provide a measuring and search system which as a central command and monitoring system is not only 35 able to monitor for instance a safety zone but comprises further capabilities which ease the recovery of projectiles.

Accordingly the present invention provides a multi-functional measuring and search system comprising 40 detector means for detecting objects such as projectiles, moving above a water surface and a computer connected to memory and display devices for evaluating and displaying detected data, including means for memorizing a search and recovery cadastre, and 45 means for detecting the impact point of the projectiles at their impact on the water surface by means of the detector means, computing the impact point on the sea bed below the water surface taking into consideration the projectile ballistics and indicating the most 50 likely position for recovery as a function of the detected values and the recovery cadastre.

An embodiment of the invention will now be described, by way of example, with reference to the drawings, in which:

55 Figure 1 shows a bay in which the measuring and search system is installed;

Figure 2 shows the same bay including the topography of the ocean floor;

Figure 3 shows the measuring and search system;

60 Figure 4 is a block diagram of the measuring and search system;

Figure 5 shows further details of the computer system of Figure 4; and

Figure 6 shows a graphic display on a display unit.

65 Figure 1 shows a bay, with a gun 12 on the shore and

a rocket launcher 14 on a platform 10 shooting into it. Within the bay a target zone 16 is defined within which the different projections are to fall, and around this target zone 16 at a predetermined distance a safety

70 zone 18 is arranged, into which no vehicles, such as fishing vessels 20, are allowed to intrude, either from the air or on the water. Marker buoys 22 serve to mark this safety zone 18. Intrusion of a vehicle 20 into the safety zone 18 must be detected in order to interrupt

75 the launching operations in this event. Monitoring is done in central command station which is included in a container 24 and is installed on shore. In the usual manner a radar device 26 can monitor the air space and the ship traffic within the bay. This radar device 26

80 preferably is switchable into a splash spotting mode in which it is capable of detecting the position of the column of water and spray of the projectiles hitting within the target zone 16. Such a splash spotting radar without trajectory computation is capable of detecting

85 the position of the column of water and spray, the coordinates of this position being determined and processed by the measuring and search system in a manner further to be described.

Figure 2 shows that, in addition to the radar device

90 26, sonar devices 28 may be tied to the sea bed at the four corner points of the target zone 16 in order to evaluate the location of impact of the projectiles 30, 30' by means of sonar delay time measurements, so that at low tide those projectiles may be recovered

95 within the target area 16. To this end furthermore the topography of the target zone 16 is sensed, for instance by echo sounding in an x, y, z-coordinate lattice, and is memorized in a corresponding file.

Figure 3 shows the central command and monitor-

100 ing station which is connected to the radar device 26 and to the sonar devices 28 and is included within the container 24. This command and monitoring station comprises a central computing system 32 having a disk unit 34 and a tape unit 36 as mass storage devices.

105 As output devices a printer 38 and a graphic display 40 are provided. A similar graphic display 42 with a keyboard may be used as an input/output terminal. The same components are shown in Figure 4 again in a block diagram.

110 With reference to Figure 5, the coordinates of each column of water and spray when a projectile hits the water surface are sensed by the radar device and/or the sonar device, and are memorized in a first memory RAM 44. A second memory RAM 46 memorizes

115 ballistics data of different projectiles, i.e. in particular the velocity v and the impact angle  $\alpha$  which depend on the shooting distance and the aiming angle. A third memory RAM 48 memorizes the recovery and salvage cadastre, i.e. the topography of the ocean floor and its

120 nature (mud, sand, rock), as well as the tide calendar on which the water level above each topographical point depends. From all those memorized values a central processing unit 50 under control of a recovery and search program memorized in a ROM 52 com-

125 putes the precise location of impact of the projectile on the ocean floor within the target area and the depth of penetration of the projectile. On a CRT display device or a printer 54, respectively, both data are indicated or outputted, so that at low tide within the target zone the projectiles may be recovered with less expenditure.

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Figure 6 shows an example of a possible traffic display on a CRT. With the use of a suitable colour graphic control program, various symbols from a data base may be displayed. Those symbols may include

5 the target zone 16, the safety zone 18, the marker buoys 22, fishing vessels 20, the sonar devices 28, the radar device 26, the central command station 24, the weapons 12 and 14, and the shore lines. Further symbols may indicate for instance a monitoring boat

10 58, a light house 60, an observer 62 and a flashing light 64 for signalling a violation of the safety zone 18. In the same manner with a symbol 66 the location of impact of a projectile may be indicated. A further area of the screen may be used to display alphanumerical data

15 concerning the range of a shot, the number of rounds, the impact point, etc. The above described system particularly serves also to indicate those areas into which rounds may be fired without the projectiles being lost.

## 20 CLAIMS

1. A multifunctional measuring and search system comprising detector means for detecting objects such as projectiles moving above a water surface and a computer connected to memory and display devices
- 25 for evaluating and displaying detected data, including means for memorizing a search and recovery cadastre, and means for detecting the impact point of the projectiles at their impact on the water surface by means of the detector means, computing the impact
- 30 point on the sea bed below the water surface taking into consideration the projectile ballistics and indicating the most likely position for recovery as a function of the detected values and the recovery cadastre.
- 35 2. System according to claim 1, wherein the recovery cadastre includes in a coordinate lattice the topography and particulars of the nature of the sea bed below the water surface.
- 40 3. System according to claim 2, including means for taking into account the water level as a function of the tidal differences.
- 45 4. System according to one of claims 1 to 3, including a radar device as a detector which operates in a splash spotting mode or may be switched to that mode.
- 50 5. System according to claim 4, wherein the radar device is switched into the splash spotting mode at triggering of a shot.
6. System according to claim 4, wherein the detector means include a sound location device.
- 50 7. System according to claim 6, wherein the sound location device comprises four sound location units located at the corners of an impact zone.

GB002165715A

Apr. 16, 1986  
Measuring and search system

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APPL NO: GB 08522390  
DATE FILED: Sep. 10, 1985  
PRIOR-AP: DE 03433146A Sep. 10, 1984  
INT-CL: [4] G01S13/88  
EUR-CL: G01S5/00; G01S13/86

## ABSTRACT:

A multifunctional measuring and search system monitors the intrusion of objects, in particular fishing vessels (20), into a safety zone (18), and additionally monitors the impact of projectiles within an impact zone (16) by means of a radar device (26) which is put into a splash spotting mode at triggering of a shot so that the location of the column of water and spray may be detected. By means of memorizing a recovery or salvage cadastre, i.e. the topography and nature of the ocean floor, and taking into consideration the variable water level it is possible to compute and to display the location of impact and the **penetration depth** of said projectiles on the **ocean floor** when taking into account the impact angle resulting from the projectile ballistics and the velocity of said projectiles. <IMAGE>